STEGOCEPHALIA OF SENEKAL, O.F.S.

By Dr. E. C. N. van Hoepen, M.I.

(With nine plates and one text figure.)

The remains, which are being described in the following pages, were discovered accidentally by some children in a quarry near Senekal, Orange Free State. The father of one of them heard of a stone which they had found and which contained black markings, quite resembling teeth. The next morning he searched the quarry and started excavations, with the result, that a large mass of fossil remains was found. These remains were eventually bought by this institution ; a few parts had, however, previously found their way to the Museum of the University College at Johannesburg. While still at Senekal, I found that many parts of the fossils were missing. Several fragments were thereupon discovered among the debris of the quarry. A caudal vertebra was also seen in the solid rock, and this led to the excavation of a large part of the tail of one of the fossils. Many houses in Senekal having been built of stone from this quarry, it was not impossible that fragments of the fossils had been distributed all over the village. A search was therefore made at likely places and a good many fragments were actually found in contractor's debris near a store, which had been recently built. Some time afterwards a large skull, of which the skull top and front end were missing, was bought from a resident of Senekal. A few months ago the Bloemfontein Museum acquired a nearly complete fossil from the same quarry ; this belongs to the same species as our fossils.

The remains in our possession belong to three individuals of the same species. The skeletons are at touching distance from each other and fairly parallel. The vertebral column does not cover the median line of the ventral dermal ossifications, but is displaced to the right of this line in all three specimens. All the bones are still articulating. The position of some of the legs suggests that the animals had been doing their utmost to remain in their places. Most of the remains have been fitted together in two large masses. The smaller of these masses is the covering portion of the larger one. As we have only got fragmentary parts of the skulls, these could not be fitted to any of the skeletons. The skull fragment, which has been chiefly used in the preliminary description (2), belongs to the specimen to the left in the large mass. It was taken out of the matrix by its discoverer.

Myriodon senekalensis, v. Hoepen.

Myriodon senekalensis	...	E. C. N. van Hoepen, Ann. Transvaal Mus., Vol. III, No. 2, pp. 102–106, Pl. I, II. Iss. 26th Oct., 1911.
Rhinesuchus major	...	R. Broom, Trans. Geol. Soc., South Africa, Vol. XIV, pp. 79–81, Pl. XIII, fig. 1, 2. Iss. April, 1912.

THE SKULL.

The following portions of the skull are present :

One skull of which the total roof is broken away and of which the front part with the outer nares and the quadrato-jugal portions are missing. A piece of the outer impression of the right hinder portion of this skull is also present. This fragment shows a portion of the border of the right orbital cavity. For convenience the fragments belonging to this skull will be called " skull No. 1 " in the following pages.

Another skull is represented by two adjoining parts, which show the right orbit, the right auditory notch, and the foramen magnum. The roof-bones of this portion have become detached and now show their inner surface. This skull will be called " skull No. 2."

There is a large fragment of a right mandibular ramus, with parts of a right maxillary, palatine, and pterygoid. All these pieces belong together and were chiefly used in the preliminary description. It is not impossible that they belong to skull No. 2.

From these fragments the following has been established :

The skull has the shape of a trapezium with the corners rounded off. It is longer than broad and very flat. The quadrato-jugal portions projected further backwards than the condyles. There is a slight longitudinal depression right along the middle of the skull, reaching from the dermo-supraoccipitals to the premaxillaries. Immediately in front of each orbit the skull surface is heightened into a broad, low thickening. The orbits are situated at the front end of the hinder third part of the skull. The nostrils are far in front. As far as can be made out from remnants, the whole of the outer surface of the skull and the lower jaw was covered by pits and their dividing ridges.

The orbital cavities are somewhat longer than broad, and it seems that their circumference was not very regular.

The nostrils are smaller than the orbital cavities and just about as far apart as these.

Judging by the broken off matrix the skull had a fairly large parietal foramen.

In this general description of the skull I may mention the otic notches. A small part of the right otic notch is visible in the outer impression of skull No. 1. In skull No. 2 the otic notch is better preserved. From these specimens can be gathered, that the otic notch in the skull surface is long and narrow, and that its edges converge slightly towards the inner end. The otic notches converge strongly towards the front. The length of the notch is at least 65 mm. and its general breadth less than 10 mm. It is bordered on the inside by the tabular and supra-temporal and on the outside by the squamosum. The otic notch becomes broader from below upwards.

With regard to the composing bones of the skull roof little can be said. It has been a very difficult matter to follow up the defective impressions of would-be sutures, and some of them still remain doubtful. The following seems to me all that can be gathered from our specimens in this respect :

The frontals are very long and narrow, extending from the parietals far forward towards the nasals, between which they wedge in. Their length is about a third of that of the whole skull. The suture with the parietals could not be found.

The parietals together seem to be broader than long ; the posterior half is broader than the anterior.

The postfrontals separate the frontals from the orbits. They are very narrow in front where they are in touch with the prefrontals and they gradually broaden posteriorly. They terminate at about the middle of the hinder rim of the orbit against the postorbitals and their posterior end nearest to the parietals is in touch with the supratemporals.

The prefrontals are very large and broad. They form the whole front rim of the orbit. The position of the lacrymal could not be ascertained, but I take the lacrymal to be at the front and outer end of the prefrontal. The combined bones reach further forward than the frontals. At their anterior end they are separated from the anterior end of the frontals by a posterior process of the nasals.

The jugal is a large bone, which is very broad at the orbit. It forms the greater part of the outer side of the orbital rim. Its boundary with the maxillary could not be found. Posteriorily it is bordered by the postorbital and the quadrato-jugal ; possibly also by the squamosum.

The postorbital is a relatively small bone, which forms the hinder and outer part of the orbital rim. Its transverse dimension is slightly greater than its longitudinal.

No sutures could be found between the squamosum and the quadrato-jugal. The tabular is a small triangular bone, which does not reach up to the anterior end of the otic notch. The dermosupraoccipitals are very broad bones.

The ossification centrum of the supratemporal lies at the inside of the anterior end of the otic notch. The sutures of this bone with the squamosum and the dermosupraoccipital could not be made out.

Excepting the prevomer portion and the hinder process of the pterygoids, the bones of the skull base are well preserved (Pl. XVIII, XXIV, fig. 8).

The basioccipital is not visible from below, its whole lower surface being covered by the basisphenoid. While trying to develop the occipital condyles of skull No. 1, the hinder right end of the basisphenoid broke away, thus showing another bone, separated from the basisphenoid by a sutural surface. This other bone is the basioccipital and can be followed to the left side of the basisphenoid all along its hinder end, beyond which it projects slightly. This specimen shows the basioccipital is very broad. In skull No. 2 the basioccipital and the basisphenoid have been broken longitudinally along their middle. The sutural surface between the two bones is clearly visible and the basioccipital is found to be a short and very thick bone. Its upper part terminates abruptly in front, but its lower part continues a short distance as a very thin, broad and flat process. The breadth of the bone in skull No. 1 is about 38 mm. and in skull No. 2 it is 28 mm. (here it has suffered from side compression). Its length in skull No. 2 is 31 mm.

The basisphenoid is a broad, flat bone. Its lower surface is slightly hollow. In skull No. 2, where the right side of the bone is well preserved, the surface is seen to be slightly raised at the inner end of the lateral posterior process (Pl. XXIV, fig. 3). The lower surface of the portion of the bone between these convexities, i.e. the middle part of the hinder end of the basisphenoid, is concave from side to side and convex longitudinally. In the middle behind, the bone forms a slight process, which reaches to the hinder end of the basioccipital. On either side behind, the basisphenoid forms a flat and broad horizontal process, which is directed towards the corresponding condyle. Between this process and a higher portion of the bone there is a transversely elongated cavity. Similar

processes occur in *Cacops* and *Trematops* and according to CASE (3, p. 132) they correspond with the hypapophyses of the *reptilian* basisphenoid. There is a groove on either side behind these processes. This groove bends upwards and forwards between the pterygoid and the corresponding condyle.

No suture has been found between the basisphenoid and the parasphenoid. The sutures between the basisphenoid and the pterygoids are clear.

The greater part of the lower surface of the basisphenoid is covered with minute teeth (Pl. XVIII.) Its hinder portion, however, is smooth and bare. The boundary between the smooth and teeth-covered surface has the shape of a hyperbole, with the apex near the middle of the lower surface of the bone.

The parasphenoid is long and slender, connecting the prevomer with the basisphenoid. Broad in front, it gradually narrows down to where it joins the rhinencephalic chamber. Thence it broadens towards the basisphenoid. Its lower surface is smooth, except at the junction with the basisphenoid. Here a tongue-shaped surface, connected with the teeth-covered surface of the basisphenoid, is also covered with minute teeth.

The pterygoid, from the articulation with the basisphenoid, sends out a transversely horizontal process, which soon bends forward to join the palatine. It also sends a horizontal process towards the quadrate. This process, from its point of origin, forms a thin, internally concave, upright plate, which is suturally connected with the edge of the bones forming the outer border and inner end of the otic notch. The upper front end of this plate is connected with the supratemporal.

Of the palatal surface of the pterygoids only that of the process towards the palatines is known. This is largely covered with numerous small teeth. The pterygoids of skull No. 1 show a bare strip of palatal surface directly behind the palatines. Only a short portion of the bone along the palatines is known. This is also covered with small teeth. Further forward only the outer border of the right pterygoidal vacuity has been developed. This border shows small teeth right up to the prevomer.

The palatines are long slender bones, which probably form the anterior borders of the infratemporal fossae. Their anterior ends are unknown. Near the middle of the lower surface there is a narrow, longitudinal ridge, which supports a series of large teeth. These teeth are clearly pleurodont, the ridge on which they stand projecting up to a third of their height along their outer side. The ridge starts near the hinder end of the palatine, but it is unknown how far it extends forward. The teeth on this ridge show the same dimensions as those on the maxillary and diminish in size backwards (figured in 2). On both sides of the ridge the palatine, for so far present, shows a smooth surface.

Only a small strip of the hinder border of the prevomers is present. Near or at the junction of prevomer and palatine there are small teeth. This is the only part of the lower surface of the prevomer preserved.

The occipital surface of the skull is badly preserved. In skull No. 1 only the outline of the foramen magnum is visible, which is triangular. The height of this triangle is 20 mm., and the length of its base 25 mm. The right occipital condyle is well preserved in skull No. 2 (Pl. XXIV. fig. 3). The articular surface is slightly concave from above downwards

and slightly convex from the inner side outwards. It is surrounded by a narrow ridge on the upper, outer, and lower sides. The whole surface looks slightly inwards. This condyle is separated from the basioccipital and the central hinder process of the basisphenoid by a deep notch, which terminates on the lower surface below the middle of the hinder lateral process ; on the upper surface (in the brain cavity) it reaches nearly as far forward as the basioccipital. A portion of the left condyle is present, but very much distorted and pressed on to the left side of the upper surface of the basioccipital. The matrix between the condyle and that bone, however, shows that an identical notch existed also on this side. The medullary surfaces of the exoccipitals, or rather the upper surfaces of the condyles, show on each side two foramina, one behind the other.

There is a suture between the exoccipital and the basisphenoid just below the outer edge of the hinder lateral process of the last-mentioned bone. The exoccipital processes extend towards the tabularia, which they join at the under side. In the middle of this process there are markings, which convey the impression of once having belonged to a suture. The outer half of this process would then be the opisthoticum.

The occurrence of two foramina on the upper surface of the condyles is very remarkable. They occur just there, where one expects to find the passage for the vagus nerves. One of them must indeed have served this purpose. If the other is taken to be the exit of the hypoglossus the results of a recent study of v. HUENE'S are contradicted (**4**, p. 103). The same difficulty was encountered by SCHROEDER in his description of *Capitosaurus helgolandiae*. SCHROEDER draws the attention to some foramina on the outside of the condyle. One of these foramina, a small one, is situated above the rounded, hinder edge of the exoccipital ; another, much larger one, just below this edge. In *Myriodon* there are two foramina in the same relative position as those just mentioned in *Capitosaurus*. The lower one is slightly larger than the upper one and is situated there, where one would look for the exit of the vagus group (Pl. XXIV, fig. 3). SCHROEDER assumes that the upper one might be the exit of the hypoglossus. The upper foramen in *Myriodon* is double, i.e. the foramen is really a depression, at the bottom of which there are two foramina. On the lower surface of the condyle in *Myriodon* there are two other foramina. The one is very small and situated at the lower end of the base of the exoccipital process, in front and slightly to the inside of the foramen for the vagus group. This foramen apparently corresponds with the small one which SCHROEDER found in the same position in *Capitosaurus* (**6**, p. 254). The other is larger and situated near the lower inner border of the condyle. What the relation of all these outer foramina is to the two inner ones could not be established with certainty. Our material is too scanty (there is only one perfect condyle and just a fragment of another present) to go further into the question. The notches which separate the condyles from the basioccipital and basisphenoid seem to correspond to the opening in the floor of the foramen magnum in *Capitosaurus helgolandiae*, and must as this have been filled with cartilage.

In both skulls a large epipterygoid is seen to be present. It is a broad flat bone behind, resting against the outer front end of the upward process of the pterygoid. It nearly reaches the skull roof in this region. The lower border of this bone is in touch with the pterygoid up to about half its length forward. The upper border is strongly concave, thus leaving a large opening between the skull roof and this bone. The front

end of the bone is thicker and narrower and bends strongly upwards to unite with the corresponding parietal.

Only a small portion of the brain case could be laid bare. All that is known about the hinder end of the brain case is mentioned in the discussion of the exoccipitals. In skull No. 1 a portion of the front end of the brain case is exposed to view. The wall of the brain case in this part is very thick and the inner surface seems to be rough. It is sometimes difficult to make out whether a certain portion is matrix or bone. The top of the brain case is covered by a very thin plate of bone extending from a little distance in front of the parietal foramen to the extreme front end of the brain case. This is situated in front of a line connecting the middle of the orbits. In the front end of this thin plate there is a deep notch. The plate seems to be a portion of the bone forming the walls of the brain case. Its upper surface is smooth and it was apparently separated from the portion of the parietal in the skull roof immediately above it by a very thin layer of matrix.*

The lower jaw is represented by three fragments, which, fitted together, form about two-thirds of the right ramus (Pl. XIX, fig. 1).

The dentary is a long slender bone. At the front end, where the ramus is broken off, the angular still surpasses it in height. Towards the back its height diminishes. Its hinder end is broken away, but from impressions of the bones on the matrix in this region may be gathered that the dentary was in touch with the surangular. It could not be made out whether any overlapping took place. The outside of the dentary forms a high ridge along the outer side of the teeth. The outer surface of the dentary is covered with coarse, longitudinal striae behind; more forward these striae become shorter and thicker.

The angular forms the greater portion of the outer surface of the ramus. The bone is highest in the vicinity of its thickend ossification centrum, which lies near its hinder end. The outer surface of the hinder part of the bone is covered with thick ridges, which radiate from the ossification centrum. The outer surface of the front part is unknown. From the front backwards the angular becomes gradually higher, until it meets the surangular. From this point it quickly subsides to end perhaps in the vicinity of the articular. How far it really goes cannot be ascertained, because the hinder part of the ramus is still intact and as usual the rough bones do not show sutures. The angular only shows a small surface at the ossification centrum on the inside of the ramus. This surface lies at the hinder end of an infra-Meckelian vacuity. In front of this vacuity another small surface of the angular is visible.

The surangular forms the hinder half of the upper border of the supra-Meckelian vacuity. The bone is relatively thin and bent in an S shape, its upper part being convex inwards and its lower part convex outwards. The upper part of its outer surface is smooth; this portion was apparently covered, in a closed mouth, by the quadrato-jugual. The lower part of the outer surface is covered by deep pits and ridges. The sutures with the angular and the articular could not be made out.

* The bone which surrounds the front end of the brain case could only be identified with the "rhinencephalic chamber" of American *Stegocephali*. In our specimen it was impossible to find its limits. In a recent comparative study ("On the Skull of a Pariasaurian Reptile, and on the Relationship of that Type," P.Z.S. 1914, Pt. 1, p. 155) WATSON, however, succeeded in identifying this bone with the sphenethmoid of the frog. This valuable work only reached us a few weeks ago, after the MS. of this paper had been sent to the printer, and therefore no full use could be made of it.

The articular is broad behind. It apparently fits into a hollow of the quadrate. Nothing can be said of the articulation surface as the quadrate is still in position on the articular. The quadrate passes a short distance down along the outside of the articular.

The connection between the prearticular and the articular is not quite clear, because this region is somewhat crushed. Apparently these bones meet on the inside of the articulation surface. From there forwards the prearticular rapidly becomes a very high bone, reaching its highest point behind the middle between the ossification centrum of the angular and the hinder end of the mandible. The upper edge of the hinder part of the bone, up to its highest point is covered by a bone of the skull roof, apparently the quadrate. From its highest point forwards the bone very rapidly decreases in height and becomes narrowest above the ossification centrum of the angular. Further forwards it becomes higher again until the front end of the infra-Meckelian vacuity is reached, whence it gradually diminishes forwards. The hinder portion of the bone up to its highest point looks inwards and downwards and the portion in front of its highest point inwards and upwards. The whole of the inner surface of the bone is covered with striae, which seem to radiate from a point somewhere below its highest elevation.

There is no indication of an opercular in the parts preserved. If present it was situated further forwards.

The complementary is a very long, slender bone. Unfortunately both ends are missing. It may have been in touch with the surangular, the hinder end of the preserved portion of the complementary, which is situated a little in front of the junction of the dentary and the surangular lies on the upper edge of the dentary. Forwards it passes directly downwards on the inside of the upper edge of the dentary. Opposite the last tooth in the dentary it is already lower than this edge. Further forwards, continuing along the inside of the dentary, its position becomes gradually lower. It is apparently wedged in between the dentary and the prearticular. The upper inner surface of this bone, from a short distance in front of the hinder tooth of the dentary up to its front end as far as preserved, is covered with numerous minute teeth. As far as I am aware, this is the first time that these teeth are regarded to be on the complementary. In the preliminary description of these fossils this bone could not be identified with certainty and the prearticular was then regarded to be the splenial. A comparison, however, with the recently described lower jaw of *Lystrosaurus* (7) led me to the above identification of the bones.

The supra-Meckelian vacuity is very long and broad. It reaches from below the last tooth on the dentary probably up to the articular. Its front end looks inwards and its hinder end upwards. The inner border behind and the lower border in front is formed by the prearticular. Its upper border in front is formed by the complementary and its outer border behind by the surangular. Perhaps a hinder border is formed by the articular.

The infra-Meckelian vacuity is much smaller. Its hinder end lies a little further back than the front end of the supra-Meckelian vacuity. It is very long and narrow and bordered by the angular below and the prearticular above.

While developing skull No. 1 some remains of the hyo-branchial skeleton were found. These consist of a large row of small bones, which are nearly in a straight line and another smaller row of bones which form a bent line. The straight row consists of ten elements ; in the bent row there are four. If the ten elements of the straight row are numbered from one end, we get Nos. 1–4 in a continuous line ; No. 5 lies parallel against No. 3 ; No. 6 lies parallel against No. 4 ; Nos. 5–10 also form a continuous line, parallel to that of Nos. 1–4. Nos. 1 and 2 are of about equal size and larger than the others ; these are also of about equal size. The two first elements bear a series of tooth-like processes on one edge. These teeth are very long, slender, sharp-pointed cones. As they have been noticed on some of the other elements it is probable that they occurred on all. I must mention here that most of the elements are broken and some of them are only represented by their impression on the matrix. Also, in the course of development, other elements of the same kind have been met in isolated positions in the matrix, and owing to their very delicate nature, were unfortunately destroyed. The length of elements 1 and 2 was about 17 mm., their height about 4 mm. and their thickness may have been 2 mm.

The other elements have a length of 13 mm. and less. The length of the teeth is less than 3 mm.

It is impossible to say which arches are represented. It is not improbable, however, that there are both hyoidean and branchial arches. In the first place there seem to be three distinct series of elements, which could be taken as the remains of three arches. Secondly, the number of elements is sufficient for three arches. Whether these branchial arches bore gills only during the earlier lifetime of *Myriodon* is a question which cannot be answered from the present material.

THE TEETH (Pl. XVIII). There is a row of large teeth on each maxillary, palatine and dentary. These teeth diminish in height backwards. Further, the palatal surface of the pterygoids and partly also of the basisphenoid is covered with multitudes of small teeth. Similar small teeth occur near the junction of the palatine with the prevomer and are probably situated on the latter. The upper and inner surface of the complementary also bears small teeth. Somewhere near the junction of the palatine and the prevomer there is a large tooth, visible on either side. On the right the tooth itself is still preserved, on the left there is only an impression in the matrix. The exact position of this tooth is not clear, but it seems that it is situated at the front end of the row of teeth on the palatine and directly behind the hinder end of the choana. In front and to the inside of this large tooth there are some smaller ones, which have about the size of the lesser ones on the palatines. The rows of teeth on the maxillary, palatine, and dentary are pleurodont.

The teeth on the dentary are best displayed on the fragmentary right ramus of the mandible already mentioned above (Pl. XIX, fig 1). Parts of the mandible and of the maxillaries of skull No. 1 have been preserved, but the rows of teeth are in a very poor condition. On the portion of the right ramus of the mandible there are 29 large teeth, which project beyond the outer edge of the dentary. These teeth are sharp-pointed and conical and direct their top inwards and backwards. A transverse section has the shape of a laterally compressed oval. The long axis of this oval makes an acute angle with the hinder end of the dentary in most teeth.

Also the longitudinal axis of most teeth is slightly inclined backwards. It could not be ascertained whether this double oblique condition is original.

The second tooth from the front end of our fragment has a length of 24,5 mm. measured along the middle of the flat side. The thirteenth tooth from the hinder end has still a length of 16,5 mm. while the last tooth on the dentary cannot have been longer than 7 or 8 mm. (only the lower half of this tooth is preserved). The mutual distance of the teeth is not the same. Mostly they stand so closely to each other that there is not sufficient room left for another tooth. This is the normal condition. Sometimes, however, they are further apart. This is the case with the three first teeth on our fragment. The space between these teeth has been partly cleared of matrix. In each space was found a small tooth, lying against the inner side of the high outer ridge of the dentary and not projecting above it. The base of these teeth is very thin and broke away during development; it is situated much higher than the base of the large teeth. The length of the small teeth was about 12 mm. Their shape was not quite clear, but is probably the same as that of the new dentition on the palatine.

The extreme end of each tooth is smooth. Below this the surface is covered with very fine ridges, running parallel with the tooth-axis. The lower two-thirds of the tooth-surface is covered with deep grooves also parallel to the tooth-axis. These grooves apparently indicate a labyrinthodont structure of the teeth. The pulp-cavity is filled with calcite. The upper end of this calcite cone is smooth, but further downwards its surface is covered with grooves, parallel to its axis. These grooves owe their existence to the penetration of plications of the outer tooth-substance into the pulp-cavity. The labyrinthodont structure hereby becomes a certainty.

The corresponding teeth on the maxillary are smaller than those on the dentary. There are 31 teeth projecting beyond the outer edge of the preserved part of the maxillary mentioned in the preliminary description. Their mutual distance is also irregular; they mostly stand closely against each other, but sometimes they are separated by a distance of more than the thickness of a tooth. The position of the preserved maxillary teeth is variable. Mostly the long axis of the oval-shaped section stands perpendicular on the line of teeth but sometimes it makes an acute angle with the front end and sometimes with the hinder end of this line. The largest preserved maxillary tooth has a length of 14,7 mm. and the smallest of 5,1 mm. The structure of the maxillary teeth is the same as that of the dentary teeth.

The row of teeth on the palatine is parallel to that on the maxillary. The twentieth tooth from behind has a length of 14,5 mm.; the fifteenth, the tenth, the eighth, and the first from behind have respectively a length of 11 mm., 10,4 mm., 9,4 mm., and slightly more than 7 mm. This row of teeth starts at about 2,5 cm. from the hinder border of the palatine; the ridge on which they stand starts somewhat earlier. The first tooth from behind corresponds in position with the ninth or tenth tooth from behind on the maxillary. Some small teeth of peculiar shape have been found on the inside of some of the palatine teeth. These teeth are not oval shaped as the ordinary palatine teeth or round as the small teeth on the pterygoid, but they are flattened and show a sharp edge in front and

behind. They apparently represent a new dentition and are ready to take the place of the adjoining large tooth.

The large tooth near the hinder end of the choana has also a labyrinthodont structure.

The small teeth on the complementary, the prevomer, the pterygoid, and the basisphenoid are all of the same kind. They have a sharp-pointed conical shape and in horizontal section they are circular. On the pterygoid their size seems to vary with the place of occurrence, but this does not seem to be the case on the basisphenoid or the complementary. The largest teeth visible on the pterygoid occur near the outer border of the pterygoidal vacuities and near the front end of the infra-temporal fossa. Between these patches of larger teeth there are numerous smaller ones, which continue backwards and also cover the basisphenoid. Excepting the extreme border of the pterygoidal vacuities, the teeth on the front end of the pterygoids are unknown. Those near the junction of the palatine and the prevomer are of the larger type. The zone of larger teeth on the pterygoid shown in fig. 1 of the preliminary description is not so strongly marked as may be inferred from the drawing.

The structure of these small teeth bears a labyrinthodont character. The extreme end of the tooth is smooth ; below this the outer surface is covered with very fine ridges, parallel to the axis of the tooth ; the lower half of the outer surface is covered with grooves parallel to the tooth-axis. The pulp-cavity of these small teeth is also filled with calcite. The calcite cone is much shorter than the tooth. When the tooth has broken off very near to its base, plications of the surrounding tooth-substance are seen to enter the calcite cone. These plications, however, do not penetrate very far into the calcite.

There still remains to be described a very remarkable feature of the skull of *Myriodon*. Both skulls show a mosaic of small, irregular, and flat ossifications in the pterygoidal vacuities. This mosaic forms a tolerably flat layer, which however, is not situated in the plane of the pterygoidal edges. At its hinder end its position is higher than the lower surface of the pterygoids immediately on the outer side of the sutures with the basisphenoid. This is due to the fact that the pterygoids, in passing outwards from the suture with the basisphenoid, bend slightly downwards until they reach the middle of the hinder end of the pterygoidal vacuities. From this point they turn slightly upwards. The middle of the hinder end of the flat layer of ossifications passes below the hinder end of the parasphenoid and is therefore lower than the palatal surface of the basisphenoid. The sides and front end of the layer of ossifications are situated much lower than the inner borders of the pterygoids and the hinder borders of the prevomers. The distance from the lower surface of the parasphenoid in front to the upper surface of the bony layer is 12 mm. The distance from the hinder border of the right prevomer to the same surface of the ossifications is 9 mm.

The hinder border of the layer of ossifications is notched. The notch is very broad and short. Through this notch the hinder end of the layer consists of two processes, which project into the hinder ends of the pterygoidal vacuities. There is still some distance between the hinder border of the layer and the front edge of the pterygoids. The right side of the layer is clearly visible. It lies at a uniform distance of about one centimetre from the concave inner border of the pterygoid and prevomer,

i.e. the right border of the layer is parallel with the inwardly concave outer border of the pterygoidal vacuity. The left side has been pressed against the left pterygoid, the different elements have thereby become disconnected and scattered through the matrix. Some of them have suffered a vertical displacement of 15 mm. The front border is rather fragmentary, but still it can be seen that the front end narrows down considerably ; it fully conveys the impression that it terminates at the front end of the pterygoidal vacuities.

Most of the elements of the layer are small, polygonal, thin bones. Near the front end of the parasphenoid, however, there are some bones which are from three to four times the ordinary size. These have suffered some displacement.

The great majority of these bones have their lower surface covered with small teeth of about the same size as those on the pterygoids. Teeth were not found on those bones in the hinder processes, which were near the extremities of these parts and open to observation. These teeth present the same general appearance as those on the pterygoids. They are mostly broken off and then generally show a pulp-cavity, which with the great majority is not filled with calcite. Probably all these teeth were once filled with calcite, which subsequently became dissolved. A few teeth have been found, however, which still possessed a calcite filling. The outer surface of the teeth shows in some cases a series of fine striae near the top ; mostly, however, these could not be discerned. The great majority of sections of the teeth do not show any plications whatever of the outer tooth substance. The same applies to the small teeth on the pterygoids, where only a portion of those with calcite filling show this structure. Some of the teeth with calcite filling on the small bones also show very plainly plications of the outer tooth substance. These small teeth may therefore be regarded to have the same structure as those on the pterygoids.

The original position of this layer of bones cannot be made out with certainty. Its present position seems to suggest that it originated in the epidermis of the pterygoidal vacuities. It is, however, not impossible that this layer has been pressed into its present position during the process of fossilization and therefore that it may have originated in the epidermis of the ventral surface of the lower jaw. In the last case there would be no apparent functional difference between these ossifications and the dermal skeleton of other parts of the body. The latter, however, are plain dermal scales, while the former are for the great majority covered with teeth. These teeth do not possess the simple structure which may be expected in protective organs of the epidermis, but they show identically the same differentiation as the teeth in the oral cavity. The latter, however, have acquired the present structure through functional adaption. This again supports the probability that the teeth and ossifications in the pterygoidal vacuities originated for the performance of the same functions as the other teeth in the oral cavity. As far as I am aware small polygonal ossifications in this position have only been found once before in *Stegocephalia*. This is in *Micropholis Stowi* HUXLEY ; they were originally described as dermal scutes and recently WATSON has again described them as such. I am not in a position to state, however, whether the ossifications in *Micropholis* are of the same kind as in *Myriodon* or not. To conclude, I may contrast the arguments for and against the above-mentioned views in a table.

For the original position between the pterygoids :

1. The present position of the layer.
2. The presence of the teeth.
3. The layer apparently does not occupy a greater surface than the pterygoidal vacuities, i.e. no elements of the layer have been found on the pterygoids or the basisphenoid.
4. The right side of the layer is parallel to the concave inner side of the right pterygoid and prevomer.
5. The elements do not occur in rows, which is usual in dermal armour.
6. The probability that the layer formed part of the palatal surface is strengthened by the fact that the hyo-branchial skeleton, the dentary, the complementary and all the bones of the skull-base and palate, except the parasphenoid, were covered with teeth.
7. That the parasphenoid is not covered with teeth may be explained by the presence of the layer of ossifications, which passed over its lower surface.

For dermal armour :

1. Dermal armour is already known between the rami of the jaw, but teeth without real skeletal support have never yet been found in the *Stegocephalia*, although they are known in *Teleostei* and in *Selachii*.
2. The left side of the layer is very irregular and elements occur far below the general surface of the ossifications. If the layer was pressed into its present position, these were left behind through meeting greater resistance.

The Vertebral Column.

The vertebrae are typically temnospondylous and of the rhachitomous type. The exact number of presacral vertebrae could not be ascertained in our specimens. Twenty-six were counted, but there is still room for at least a few more between the last lumbar and the sacral vertebra ; also the connection between the last cervical vertebra and the skull is missing, so that the total number of presacral vertebrae will at least be thirty.

The hypocentrum is a latero-symmetrical bone of horse-shoe shape, resembling very much the same element figured of *Actinodon* and *Trimerorhachis*. Seen from the side, its hinder border is more slanting than the front one. Its inner surface is rough, and has probably been covered by cartilage. The outer surface of the hypocentrum is not so prominently keeled as that of *Trimerorhachis*. Many of the hypocentra, especially those near the pelvis (Pl. XVII and XIX, fig. 2), show a series of longitudinal ridges of which generally one on either side of the middle line are more conspicuous. There is also a middle ridge, which at most attains the height of the lateral ones. These ridges are separated by narrow grooves of the same breadth as the ridges. In some hypocentra it could be shown that the surface in the grooves, as in *Trimerorhachis*, shows a more conspicuous net-like structure than on the ridges. Whereas

the three ridges on the hypocentrum of *Trimerorhachis* occupy practically the whole of its lower surface, excepting the sides, they only occupy its central half in *Myriodon*. Both ends of the hypocentrum project slightly below its outer surface. The sides of the hypocentrum rise upwards, terminating in a point. The outer surface of these parts is concave and their hinder border shows a concavity, which has most probably served as articulation surface for the rib.

For so far present the presacral vertebrae have all got pleurocentra, one on each side. These elements are bent, so as to partly envelope the chorda. Their outer surface is hollow and shining and covered with a coarse net-like structure. The other surfaces are rough and were probably covered by cartilage. Most of the pleurocentra are out of their original position and have suffered through fossilization. Only a few are still near their natural position and have retained a normal shape. From these it is seen that their hinder border is slightly convex, whilst the front border is formed by two sides meeting at a very obtuse angle at the middle. The upper side stands convexly outwards, while the lower is concave outwards at its upper end. It could not be made out whether the rib articulated with the upper front part of this bone. The transverse dimension of the pleurocentra is greater than the longitudinal.

The neural arch consists of a coalesced bone with a neural spine. *The coalescing has taken place above the neural canal, but not below.* Between the neural canal and the chorda the sides of the neural arch just meet, but they do not coalesce. In the centre of this "suture" there is a round opening, uniting the neural canal with the chorda. The sides of the neural arch, enclosing the neural canal, first form two parallel, perpendicular walls and then suddenly expand into a broad flat basis. The lower surface of this basis is rough, indicating that it was covered with cartilage. The neural canal is very narrow, having a diameter of about 1 mm. The neural spine hangs slightly backwards out of the perpendicular. It is a broad, flattish bone, broader at the top than at its base and with a longitudinal ridge along its middle on either side. The condition at the lower end of this ridge is not quite clear. In some instances it seems to flatten down to the common surface of the spine, in others it seems to split into two ridges directed towards the zygapophyses. The free end of the spine is thicker than the rest and ends with a flat and smooth surface. The lower anterior zygapophyses project outwards without seeming to deviate from the horizontal. They meet the lower and outer side of the higher posterior zygapophyses of the foregoing vertebra. The anterior zygapophyses are larger than the posterior ones.

The dorsal vertebrae have developed strong diapophyses (shown clearly in three vertebrae of Pl. XVII), which diminish in length towards the sacrum where they cannot be identified from the basal plate of the neural arch. The articulation surface of these diapophyses lies all along their front and outer margins.

The single sacral vertebra (Pl. XVII and XIX, fig. 2) differs slightly from the adjoining ones. The articulation surface of the hypocentrum for the rib is larger than in the others and the base of the neural arch forms strong diapophyses.

The exact number of caudal vertebrae cannot be ascertained either. There is one caudal piece (Pl. XX) with 28 vertebrae, but the end is missing, and this can easily have had another ten. The proximal end of this piece is not in connection with the sacral vertebra and its first vertebra has distally completely coalesced chevron bones. In another

piece of the same specimen a small portion of the tail, adjoining the sacral vertebra, is preserved (Pl. XVII). This shows four caudals without chevron bones. Another specimen (Pl. XIX, fig. 2) shows a good many caudals, seven of which do not have chevron bones. The seventh, however, has already got two knoblike processes, which further backwards develope into chevrons. Whether the eighth had distally coalesced chevrons cannot be definitely made out, as they are broken off near the hypocentrum. In the ninth, tenth and eleventh vertebra they are also broken off, but their base is so well developed that I presume they were distally united. Their base also reaches from the front to the hinder border, therefore over the whole length of the hypocentrum ; this is not the case in the seventh and eighth vertebra. In the seventh the knoblike processes are situated near the hinder border of the hypocentrum, and in the eighth the base of the processes only nearly reaches its front border. Probably, therefore, the eighth caudal did not have distally coalesced chevrons. The tail of *Myriodon* did then have at least thirty-six caudal vertebrae, and may have had forty-six.

The longitudinal ridges on the lower surface of the first six hypocentra are better developed than in the presacrals ; otherwise they show no marked differences. The angle of the chevron bones as also of the neural spines becomes less towards the end of the tail. Pleurocentra are still present in the thirteenth caudal of the large piece and up to the ninth in the other. In this specimen (Pl. XIX, fig. 2) the left pleurocentra of the eighth and ninth consist of two small elements instead of one. There is only one large right pleurocentrum in the eighth while that of the ninth is missing.

The neural spines of the caudal vertebrae are each thicker in front than behind. Proximally they are, like those of the presacrals, narrower at the base, but further distally they acquire a more uniform breadth. As the chevron bones, the spines grow gradually smaller towards the end. The anterior and posterior zygapophyses are still normal and in touch with each other in the 26th caudal. Further towards the end they do not reach each other any more. The two bony elements of each vertebra in this region are far apart from each other and from those of the next vertebra, the whole indicating the presence of a great amount of cartilage.

RIBS.

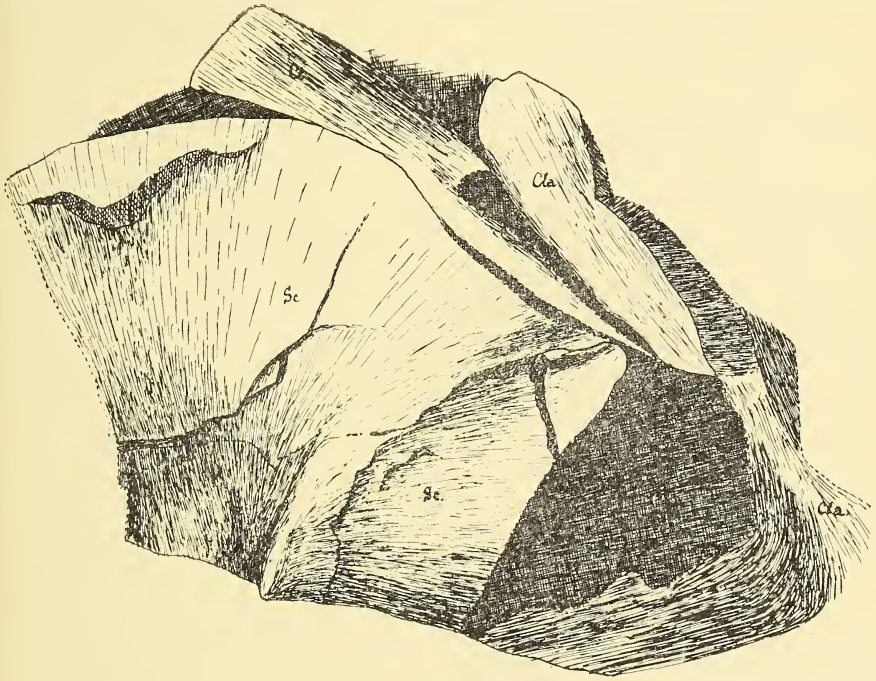
All the presacrals, as far as present, have ribs. They are present on the caudals up to the ninth vertebra. They are all single-headed, that is to say, although there is really only one proximal end, two articulation facets can easily be distinguished. These facets make an obtuse angle with each other, their adjoining border protruding slightly from the bone. The tubercular portion is thick and rounded, while the capitular portion is flatter and thinner. The lower surface of the rib between the tubercular and capitular portions is strongly concave. The shape of the ribs has been greatly changed through fossilization. From some it can be seen that they were bent, thin in the middle, and that their distal ends were broad and flat. There are indications that the more forward ribs produced a processus uncinatus from the proximal part of this flat portion.

The single sacral rib is large, and its head, though much stronger, is formed in exactly the same way as the other ribs. The two large facets are still in contact with the diapophysis and the large articulation surface of the hypocentrum on either side. The rib is slightly constricted near

its middle and its distal end is flattened. This flat portion shows an articulation surface over the whole of its lower (or hinder?) surface. This articulation surface looks mostly backwards and outwards and slightly downwards. It is not flat or smooth but bordered by ridges and covered with tuberosities. Near the upper ridge there is a fairly deep parallel groove. It seems that there must have been some cartilage between this surface and the corresponding one of the ilium.

THE SHOULDER GIRDLE.

The episternum is only represented in one specimen (Pl. XVI and XXI). Its front edge is broken off and also its right side, but this has left an impression. The left front side is also damaged. The outer surface of the bone is covered with ridges and dividing furrows, radiating from the centre. If the sides of the bone were straight it would be of rhomboid shape. The hinder angle of this rhomboid, however, is cut off and a short straight line substituted for it. The two hinder sides are slightly concave



Myriodon senekalensis. The relation of scapula, cleithrum, and clavicle.
Sc. = scapula ; Cl. = cleithrum ; Cla. = clavicle. ×0,68

and as far as could be made out the front sides are convex. The dorsal surface is flat and shows a broad flat ridge running transversely over the middle of the bone. Another broad and flat ridge starts at the end and vanishes towards the middle. The bone seems to be broader than long.

The clavicle overlaps the episternum to a considerable extent. The lower end of the clavicles is flat and very broad medially, ending here in a fairly straight line. Towards the upper part they narrow down briskly with probably straight sides to about a fourth of its greatest breadth, thus forming a triangle. The outer surface of this triangular portion is also

covered with ridges, radiating from the narrow end; the inner surface is smooth but not flat. The relation of this part to the scapula is not quite clear, although it seems to touch the front edge of the scapula. There may have been an opening between the anterior superior angle of the scapula and the bend of the clavicle. The upper portion of the bone, which is preserved in one specimen only, forms an angle of some 130 degrees with the lower portion. It is long and slender, much broader than thick and about as long as the triangular portion. The outer surface of this part is smooth. There is only one specimen showing the relation of clavicle, cleithrum, and scapula. This shows the clavicle and scapula separated by the cleithrum. It seems to me that this is the natural relation of these bones. According to CASE (3) the same relation occurs for example in *Dissorophus* (p. 118), but it seems to be different in *Eryops* (p. 100).

The cleithrum is a long slender bone, which covers nearly the whole top of the scapula but is not suturally united with it. The anterior end of this bone lies slightly in front of the superior anterior angle of the scapula. There it lies against the hinder part of the outer surface of the cleithral end of the clavicle. Higher up the cleithrum bends behind this bone. Clavicle and cleithrum are not suturally united.

The scapula-coracoid is a large bone with no indication of a suture between the composing parts. The upper part is broad and thin and slightly bent inwards. The inner surface of this portion is transversely convex, while its outer may have been correspondingly concave. Its upper border is convex behind and slightly concave in front. As these properties are only concluded from impressions, nothing can be said of this border with regard to cartilage. If this has been present it can only have been a small quantity, as the cleithrum fits nicely into the slight concavity and over part of the convex border. The anterior border is thin, and still represented by small fragments. The posterior border is thick and its lower part is still present together with the whole lower portion of the bone in a left scapula-coracoid.

The posterior border divides in its lower half to include the supraglenoid fossa (Pl. XXIV, fig. 2). The outer portion of this border does not extend so far backwards as the inner; it is much thinner than this and continuing downwards, curves backwards to terminate at the upper and outer end of the glenoid facet. The inner and much thicker portion of the hinder border makes a much stronger curve downwards, inwards, and backwards, towards the inner end of the glenoid facet. This facet is very long and comparatively narrow, mostly so beneath the lower end of the supraglenoid fossa. The position of the facet is from outward to inward and backward looking slightly downward. Its edges project from the general surface, thereby denoting that the facet has been covered by cartilage. The connection between the humerus and the scapula-coracoid was through the medium of cartilage, as the proximal end of the humerus is built on the same principle. The outer end of the glenoid facet marks two different portions of the bone in as much as the upper part is bent along a line running from this end horizontally forward. These portions enclose an angle of about 90 degrees. The lower portion is thin, long, and moderately broad (Pl. XXIV, fig. 1). Its inner border is elliptical, while its hinder-outer border is only slightly convex and curves concavely into the lower margin of the glenoid facet where this is narrowest. The extreme front of the part where the two portions meet is lost. The lower portion contains two foramina: the one is situated near the outer

edge, in front of the glenoid facet and slightly nearer to the hinder margin than to the front; the other is situated near the middle line of the flat portion and opposite the termination of the hinder-outer border on the lower margin of the glenoid facet. The first mentioned is the supracoracoid foramen, the last is the glenoid foramen. The glenoid foramen pierces the bone upwards and opens on the inner surface behind the lower end of the subscapular fossa. The supracoracoid foramen opens on the outer surface to continue for a short distance as a slight impression on the flat lower portion of the bone. It pierces through to the other side in a direction parallel with this flat portion outwards and slightly forwards and opening on the inside in the lower end of the subscapular fossa. This fossa extends in the same direction upwards. It is also nearly parallel with the coresponding front border of the bone. At its upper end it broadens to receive the inner opening of the supraglenoid foramen, which pierces the bone from the upper end of the margin of the outer supraglenoid foramen in a backwards-forwards direction. The supracoracoid foramen is larger than the glenoid foramen and the supraglenoid foramen is the largest of all.

THE FORE-LIMBS.

There are three fairly complete fore-limbs, two right ones and a left one and fragments of another left one (Pl. XVI and XXI).

The humerus. There is one humerus of which only a distal portion is broken off. Another is only represented by its distal portion and the impression of the proximal end. The other two are badly broken. From these bad specimens one would conclude that the two ends of the bone make an angle with each other as in *Eryops* for example; but the better specimens show that the ends expanded in the same plane. This of course would be a peculiar difference from the other large *Temnospondyls* as *Actinodon*, *Eryops*, *Cacops*, etc. I am, however, not quite sure of this position although it seems very probable.

The indifferent position of the humerus in life must have been from the glenoid facet slightly downwards and backwards. The articular face on the proximal end forms a large cavity, the edges protruding far from the general surface. If the bone lies flat in its natural position, it is the upper edge which projects farthest. This cavity must have been filled with a large amount of cartilage. The upper surface of the proximal end is convex, the lower slightly concave. Towards the shaft the hinder border bends further downwards than the body of the bone. There were two slight projections in the centre of the upper surface.

The distal end is broader than the proximal one. The articulation part is strongly convex. On the lower side the bones show a small ridge, visible as an impression in the matrix and running transversely over the bone. This ridge is distally stronger concave and defines the lower and inner border of the articulation facet for the radius. There is a thick, broad and high ridge on the upper surface extending from the distal end above the already mentioned articulation surface for the radius up to the lowest tuberosity on the proximal end, gradually diminishing in height in that direction and vanishing there. The distal end of this ridge formed part of the articulation surface for the radius.

The shaft is slightly narrower than the proximal end and shows no typical features.

There are two processes on the anterior border. One is just above the slighly constricted middle and has the shape of a short, truncated

cone. This may be the same process as the characteristic one of *Eryops*. The other is situated near the lower end of the anterior border and seems to be rather flat.

The *radius* is a short bone with a square shaft of which the lateral sides are slightly concave, while the anterior side is flat; there is a longitudinal groove on the distal half of the posterior side. The proximal end is thick and nearly square, the articulation surface being flat and standing at right angles to the axis of the bone. The distal end is not so thick as the proximal and is not square, the different angles being rounded off. The articulation surface, which is hollow, does not make right angles with the axis of the bone, the inner side of the shaft being longer than the outer.

The *ulna* has the shaft bent with the concavity inwards. Its distal end is broad and flat and the articulation surface is strongly convex. The bone thickens towards the proximal end, which is broad and thick, the articulation surface being larger than that of the radius. This surface looks towards the radius, the concave inner side of the shaft being much shorter than the convex outer one. There is no olecranon process.

The *carpus* is only represented by two small bones, which are mainly situated between the radius and the first or second metacarpal. As the fore-foot is present in three complete specimens and as all three have only two carpals, I can only conclude that the others were not ossified. The proximal bone is most probably the radiale, while the other might be the first carpal.

There are four *metacarpals*, of which the first is broadest and shortest, the others being longer and narrower. The four fingers were short, and the hand gives a much weaker impression than the foot. The first and second fingers have two phalanges each, while the third and fourth have each three. In one specimen there is an irregularity with the third finger, which has only two phalanges. It seems that the end phalange is lost.

THE PELVIS.

One pelvis is nearly completely preserved, while the two others are only represented by fragments and their outside cast in the matrix (Pl. XVI and XXII). In all these cases the iliac portion of the right side has been pressed into the plane of the ischio-pubis. The left side in the two impressions with fragments is bent and generally distorted. Of the preserved specimen of the left side a large part of the ischio-pubis, bordering on the symphysis, is missing. The iliac portion stands at an angle of 45 degrees upwards and outwards. This seems to me to be about its normal position.

The ischio-pubis portion is flat and joined to its fellow by a broad symphysis which is broader dorsally than ventrally. Its seems that the two innominates joined each other without forming an angle. The hinder border of the ischium is convex, so that the two united bones are separated distally for a short distance by a notch. The outer border is slightly concave until the ilium is reached, where a small convexity marks the beginning of this bone. The suture between the ilium and the pubis is further marked by a ridge on the dorsal surface, starting from this convexity and crossing the bone in a straight line inwards and forwards.

The front border of the ischio-pubis is broader than the posterior border and slightly concave. There is an angular projection where the ilium meets the bone and the suture between the ilium and the innominate is marked by a slight ridge, which unites with the ridge starting on the

lateral border near the symphysis. The anterior border of the innominate is thicker than the lateral or the posterior border. There is probably a slight notch at the anterior end of the symphysis.

The acetabulum is deep and large and moderately concave. It has a distinct border all along its lower edge, while its upper border is only represented by a slight ridge on the middle of the lower end of the ilium, the anterior and posterior portions of the upper border not being clearly defined. The shape of the acetabulum indicates a horizontal femur, which may have been directed very slightly forward from the articulation surface. The foramen obturatum opened on the ventral surface slightly inward of the middle of the front half of the acetabular border. It is visible as a small process on the impression of three innominates.

The ilium is fixed broadly to the ischio-pubis and the axis of its lower end rises abruptly upwards. The shaft, however, bends more outwards, while the upper end again resumes the original direction of the lower end. Excepting the broad base of the bone it is long and slender with a distinctly narrower shaft. Its hinder border is strongly concave, while its front border is nearly straight, up to the base of the bone. The inner surface of the upper end, i.e. the articulation surface for the sacral rib, is rough. In front it is bordered by a thick ridge. Behind this ridge is a deep groove. It is in this groove that the ridge on the hinder border of the sacral rib fits. Behind this groove is a low ridge, which fits into the groove on the sacral rib. The surface behind this ridge, more than half of the whole articulation surface, is slightly hollow to accommodate the slightly convex part of the articulation surface of the sacral rib.

THE HIND-LIMB.

The FEMUR (Pl. XXII) is a long slender bone, which very much resembles that of *Eryops*. We have it represented in four specimens with some fragments. There are no real articulation heads, as the ends were covered with cartilage and are now rough surfaces. Both ends are broad and flat. The proximal end shows a broad and flat upper or front surface, which narrows down quickly towards the middle of the shaft. The front or inner edge of the proximal end is thin, the bone becoming thicker backwards or outwards. The hinder or outer border of this end is divided into two thin parallel ridges by a narrow groove. Towards the middle of the bone these ridges unite to form a thin ridge, which extends far from the bone along its hinder or outer side and which continues till near its distal extremity. This same ridge occurs on the femur of *Eryops* and as in that genus it gives the shaft of the bone a triangular section, the apex of which is turned backwards or outwards.

The distal end is divided into two parts by a deep and broad groove on the front or inner surface. The upper portion of the articulation surface is smaller than the lower. The central portion between the articulation surfaces, which lies at the distal end of the large groove, projects furthest, so that the articulation surfaces fall away from each other from this point. The lower surface provided articulation with the large proximal end of the tibia, while a part of the upper served for connection with the fibula. Therefore, in normal position the proximal end of the fibula would be above the proximal end of the tibia. The hinder border of the distal end shows a short ridge, which broadens out considerably at its distal end. There it unites the two articulation surfaces, lying in fact exactly opposite the broad front groove. Above this ridge the upper or front surface shows a cavity, which borders the side ridge of this surface

on the distal end. The broad central ridge terminates at about one-third of the length of the bone, above the hinder or lateral ridge of the shaft.

The tibia has little more than half the length of the femur. Its proximal end is thick, the ventral-dorsal dimension being much larger than the transverse one. Along the anterior surface of the proximal end there is a groove, which corresponds with the intercondylar groove of the femur. The greater part of the rough articulation surface articulated with the lower condyle of the femur, but a small part found itself opposite the upper condyle. The shaft is thin and has a squarish section. The distal end is only slightly thicker than the shaft. The posterior surface is flat, while the upper and lower and the anterior surface are slightly concave.

The FIBULA is a flat bone of the same length as the tibia. The proximal and distal ends are both broad and of the same thickness as the shaft. The anterior border is strongly concave, while the posterior border is nearly straight. The articulation surface of the proximal end looks obliquely downwards. The distal articulation surface makes a long curve, the inner and outer ends of which are thickened.

The TARSUS is only partially ossified. Mostly five bones are present, three proximal bones and two tarsals. The three proximal bones are an intermedium, a fibulare and a centrale or tibiale, while the tarsals may be the first and the fourth. A sixth bone may be present between the first tarsal and the large centrale, being also a centrale. The intermedium is large, with a thickened articulation-face for the fibula, a slightly shorter face opposite the tibia and a thickened distal face for articulation with the large centrale. Externally it slightly touches the fibulare. The fibulare is transversely elongate with thickened sides. Proximally it articulates with the outer thickening of the distal end of the fibula, internally and proximally slightly with the intermedium, distally with the fourth tarsale and between this and the intermedium with the large centrale. Its distal surface opposite the fifth digit must have articulated with the cartilageous fifth tarsal. The large centrale is the largest bone in the tarsus. There was still some doubt whether this could not be a tibiale, but its central position, occupying the whole distal border of the intermedium, together with its being in touch with the fibulare, compelled me to take it as a centrale. This centrale is transversely elongate, its inner end being at the same time much broader than its outer end. It articulates proximally with the intermedium, externally with the fibulare and distally on the inner side through the second centrale with the first tarsal. The tibiale and the first, third and fifth tarsals appear to have not been ossified. It could not be made out whether there might have been more than two centralia.

The digits give an impression of more strength than those of the fore-limb. They are thicker and slightly longer and the whole foot generally is broader. The first metatarsal is very short and broad, especially the ends attaining great breadth. Its first phalanx is also short and broad and the same can be said of the second phalanx, which is the stoutest end-phalanx of the lot. The second metatarsal is much longer than the first and its extremities are less expanded. The first phalanx of the second digit is longer than that of the first and it is but slightly constricted in the middle. The second phalanx is longer than that of the first digit though not so broad. The third metatarsal is just as long as or slightly longer than the second, but it is less constricted in the middle. The first phalanx is longer and stouter than that of the second digit. The second phalanx is much smaller than the first, its breadth being about

equal to half its length. The third phalanx is as long as the second of the second digit, but it is not so broad. The fourth metatarsal is slightly shorter than the third and more constricted in the middle. Its first phalanx is also slightly shorter than that of the third digit and its second phalanx has about the same length as that of this toe, but it is somewhat broader. The third phalanx is much shorter and narrower than the second. The fourth phalanx is much smaller than the third of the third digit. The fifth metatarsal is shorter than the fourth and also more slender. Its first and second phalanges are slightly shorter and more slender than those of the fourth digit. The third phalanx has the same size as the fourth of the fourth toe. All the end-phalanges show a terminal thickening. Does this give an indication of the presence of claws? From the above it will be seen that the phalangeal formula of the foot is 2, 2, 3, 4, 3.

The Dermal Covering.

Large parts of the ventral and dorsal dermal covering have been preserved (Pl. XVI, XVII, and XXIII). The ventral portion is known from the thoracic girdle to the pelvis. It consists of long, acicular, bony scutes, which have a ridge running obliquely across them ventrally. Dorsally their posterior margin forms a slight ridge. These scutes are arranged in parallel rows, which diverge backwards on both sides of a median line (Pl. XXIII). Every proximal scute overlaps the proximal end of the next distal one in such a way that the distal end of the proximal scute passes behind the ridge on the proximal end of the distal one. The median line is formed by a row of flat scales. These are the end scales of each side series, which broaden out considerably proximally and overlap each other alternately.

Towards the sides of the animal the shape of the scales changes. They become shorter and their ridges disappear, so that there only remains a small flat bone. Further dorsally they become round and they gradually lose their bony composition (Pl. XVII). The scales of the side and back of *Myriodon* were not bony but horny. These horny scales are round and they may have had a slightly raised centre (Pl. XVII). They show on the matrix as a brown colouring with an uncoloured centre. The scales near the middle of the back were larger than those near the sides. It could not be made out whether these scales also occur in rows as the ventral ones.

Near the pelvis the large ventral scales change into the same small horny ones as on the back. The change takes place on a line transversely across the median line in front of the pelvis (Pl. XVI). They are still visible at the hinder end of the pelvis, but then they disappear, leaving the matrix covered with a general brownish film. The tail was apparently naked.

The hind limbs were covered with small horny scales of the same kind as those on the back. The same was probably the case with the fore-limbs, but no definite evidence could be obtained.

Since the appearance of the preliminary description an article has been published by R. Broom on portions of *Myriodon* in the Johannesburg Museum (5). Broom refers the fossils to his genus *Rhinesuchus* and gives them a new specific name. This of course must be regarded as a synonym, since the fossils had already been named. It is also impossible to refer them to *Rhinesuchus* since the differences are too great between

the two genera. These differences have been specified in the preliminary description, but for the sake of completeness they will be recalled here.

BROOM writes about *Rhinesuchus* (**5**, p. 375) : ". . . and inside the maxilla lay the palatine with a large number of small teeth irregularly arranged, but roughly in three or four rows. The palatine teeth are considerably larger than those on the pterygoids and parasphenoid, but are only about one-third the size of those on the maxilla." On p. 376, in his diagnosis of the genus *Rhinesuchus* : " Inside of the maxillary teeth are large numbers of very small teeth, probably borne by the palatines, and covering much of the pterygoids, and continued across the back part of the parasphenoid."

From these two extracts we may conclude that the palatines of *Rhinesuchus* are covered with numerous small teeth roughly arranged in three or four rows. If this result is compared with the foregoing description it will be seen that *Myriodon* differs from *Rhinesuchus* in the following facts :—

Firstly, *Myriodon* has no small teeth on its palatines like *Rhinesuchus*.

Secondly, *Myriodon* has one row of large teeth along the middle of its palatines, which row is absent in *Rhinesuchus*.

As the knowledge of the teeth arrangements of the members of this group is sufficient for identification it will not be necessary to go further into the question.

MEASUREMENTS OF *Myriodon Senekalensis*.

Skull.

Length of preserved portion	320 mm.
Probable length of complete skull	500 mm.
Length of right interpterygoidal cavity	239 mm.
Breadth of right interpterygoidal cavity	100 mm.
Breadth of preserved portion of skull	332 mm.

Vertebral column.

Length of largest preserved portion	235 cm.
Length of presacral portion of same individual measured from front end of ischio-pubis	100 cm.
Length of same in another individual	128 cm.
The length of the largest individual is estimated at	375 cm.

Sacral rib.

Length	97 mm.
Breadth of proximal end	40 mm.
Breadth of distal end	30 mm.

Episternum.

Length as preserved	215 mm.
Breadth may have been	260 mm.

Clavicle.

Length of cleithral end	100 mm.
Breadth of ventral end at least	135 mm.

Cleithrum.

Length of preserved part	128 mm.

Scapula-coracoid.

Length of corocoidal portion	92 mm.
Breadth of upper end	125 mm.

Humerus.
Length ..... 145 mm.
Breadth of the proximal end ..... 70 mm.
Breadth of the distal end ..... 95 mm.

Radius.
Length ..... 75 mm.
Maximum breadth of the distal end ..... 26 mm.

Ulna.
Length ..... 89 mm.
Width of the proximal face ..... 30 mm.
Width of the distal end ..... 25 mm.
Thickness of the distal end ..... 3 mm.

Ilium.
Length about ..... 130 mm.
Width of upper end ..... 55 mm.

Ischio-pubis.
Length ..... 185 mm.
Maximum breadth ..... 88 mm.

Femur.
Maximum length ..... 171 mm.
Breadth of the proximal end ..... 57 mm.
Breadth of the distal end ..... 47 mm.
Thickness of the proximal end about ..... 10 mm.
Thickness of the distal end about ..... 30 mm.

Tibia.
Length ..... 93 mm.
Width of head ..... 33 mm.
Depth of head ..... 45 mm.
Width of distal end ..... 29 mm.

Fibula.
Length ..... 100 mm.
Width proximal end ..... 37 mm.
Width distal end ..... 46 mm.
Thickness of proximal end about ..... 8 mm.

LITERATURE.

1. BROOM, R. ... ... "On a New Labrinthodont (*Rhinesuchus Whaitsi*) from the Permian Beds of South Africa." Ann. South African Mus., Vol. IV, Pt. VIII, pp. 373–377, Pl. XLVI, Fig. 3. Iss. 7th May, 1908.

2. HOEPEN, E. C. N. VAN "Korte, voorlopige beschrijving van te Senekal gevonden *Stegocephalen*." Med. Transvaal Mus., Bd. 3, Dl. 2, bl. 102–106, Pl. I en II. Uitgegeven 26 October 1911, Pretoria.

3. CASE, E. C. ... ... "Revision of the *Amphibia* and *Pisces* of the Permian of North America." Carnegie Inst. of Washington, pub. No. 146. Iss. 20th Dec., 1911, Washington.

4. HUENE, F. VON. ... "Beiträge zur Kenntnis des Schädels von *Eryops*." Anat. Anz. Bd. 41, 1912, S. 98–104. Jena. (Separat.)

5. BROOM, R. ... ... "Note on the *Temnospondylous Stegocephalian Rhinesuchus*." Trans. Geol. Soc., South Africa, Vol. XIV, pp. 79–81, Pl. XIII, fig. 1 and 2. Iss. April, 1912.

6. SCHROEDER, H. ... "Ein *Stegocephalen*—Schädel von Helgoland." Jahrb. d. Königl. Preuss. Geol. Landesanst. zu Berlin für das Jahr 1912. Bd. XXXIII, Tl. II, H. 2. S. 232–264. T. XV–XXI. Berlin, 1913.

7. HOEPEN, E. C. N. VAN. "Contributions to the Knowledge of the *Reptiles* of the Karoo Formation. 2. The Lower Jaw of *Lystrosaurus*." Ann. Transvaal Mus., Vol. IV, No. 4, pp. 208–217, Pl. XVI, XVII. Iss. 22nd Aug., 1914.

EXPLANATION OF PLATES.

Myriodon Senekalensis Van Hoepen.

Plate XVI. The large mass of the remains. Three individuals are lying near to each other. Large portions of the ventral armour are still preserved. Parts of the vertebral columns, the hind and front legs and the shoulder girdle are shown in this plate. About 1 : 16 natural size.

Plate XVII. The smaller slab of the remains. This slab fits on to the large one in such a way that the vertebral column shown to the left lies in front of the large tail, shown in Pl. XVI. Attention must be drawn to the fine pieces of dermal armour. Near the middle a quantity of ventral scutes are seen to gradually pass over in round ones. At the extreme right a portion of the dorsal armour is visible. About 1 : 11 natural size.

Plate XVIII. Lower view of the palate. The basisphenoid, the parasphenoid and the greater part of the pterygoids are shown. In the inter-pterygoidal vacuities lies the mosaic of teeth bearing ossifications. 0,6 natural size.

Plate XIX. Fig. 1.—Right ramus of the lower jaw, probably of skull No. 2, and belonging to the upper individuai of Pl. XVI. Nearly 0,8 natural size.
Fig. 2.—Part of the vertebral column of the middle individual of Pl. XVI. About 0,2 natural size.

Plate XX. The tail of the lower individual of Plate XVI. About 1 : 3 natural size.

Plate XXI. Sternum and clavicles with complete front leg. About 1 : 3 natural size.

Plate XXII. The hind legs and pelvis of the middle individual of Pl. XVI. About 23 : 100 natural size.

Plate XXIII. A portion of the ventral armour near the sternal apparatus of the lower individual of Plate XVI. About 0,9 natural size.

Plate XXIV. Fig. 1.—The scapula-coracoid seen from below.
Fig. 2.—The scapula-coracoid seen from sideways, behind and below. About 0,8 natural size.
Fig. 3.—Lower view of the right occipital condyle and adjacent bones. The lateral posterior process is distinctly visible. The outer opening for the vagus group is the highest to the right. Approximately natural size.

Explanation of Plate XV.

Galeosoma coronatum, sp. nov., from Kroonstad.

Fig. 1. Dorsal view, somewhat enlarged. ♀.

Galeosoma pallidum, sp. nov., from Saltpan.

Fig. 2. Dorsal view, somewhat enlarged. ♀.
Fig. 3. Dorsal view, about natural size, showing the great depth of the marginal surface of the shield anteriorly. ♀.
Fig. 4. Ventral view, about natural size. ♀.

Galeosoma schreineri, Hewitt, from De Aar.

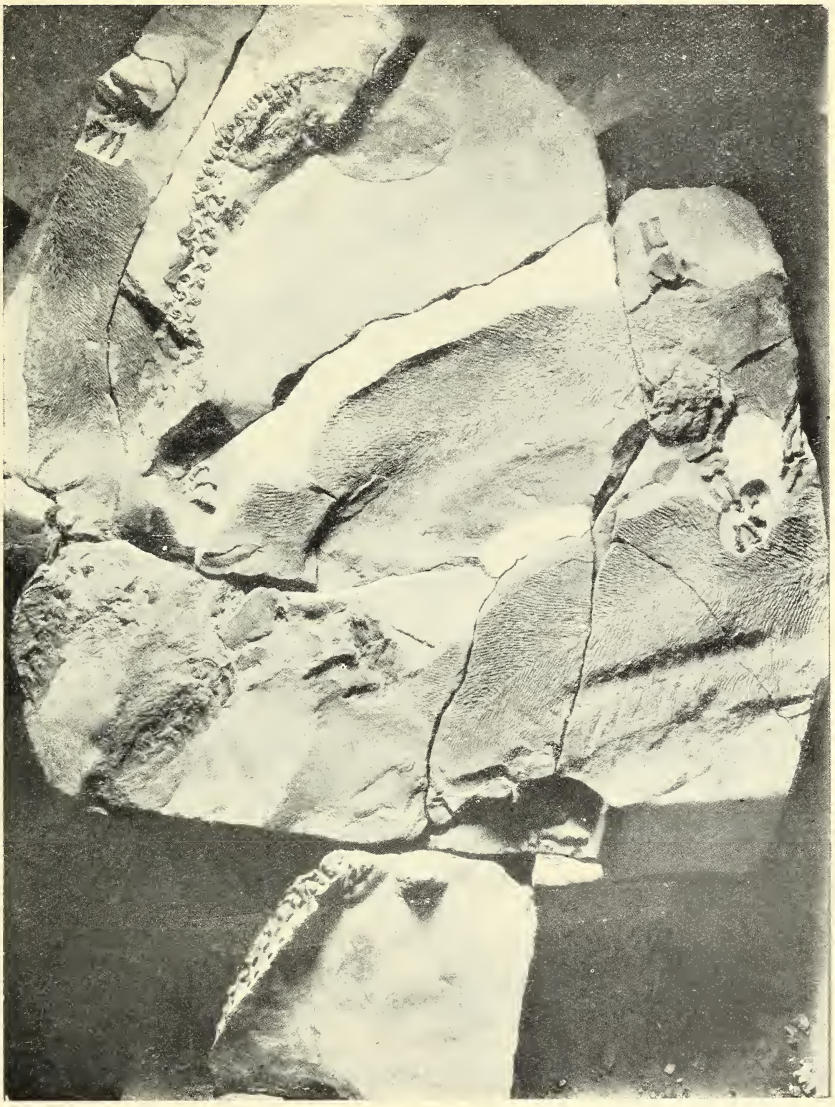
Fig. 5. Ventral view, about natural size. ♀.
Fig. 6. Dorsal view, about natural size. ♀.

Idiops gunningi, Hewitt, var. nov., *elongatus*, from Moorddrift.

Fig. 7. Dorsal view, about natural size. ♀.

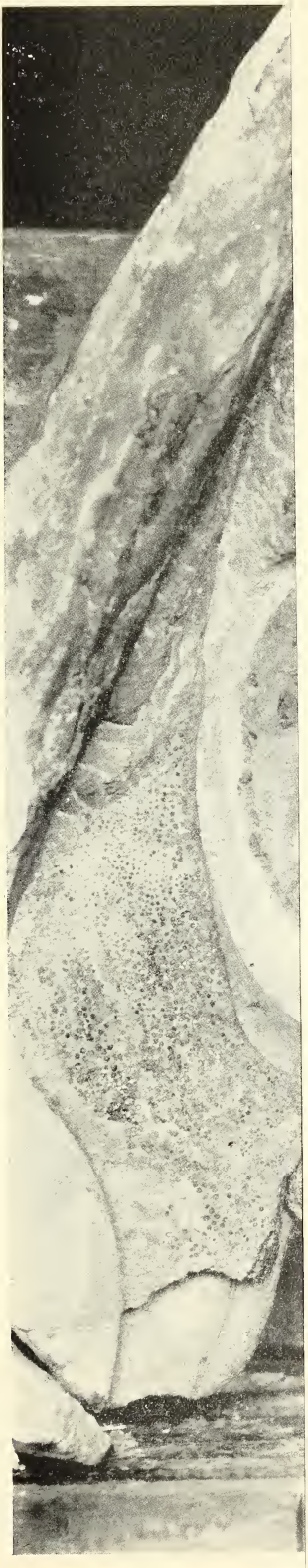
Heligmomerus caffer, Purcell, ? sp., from Moorddrift.

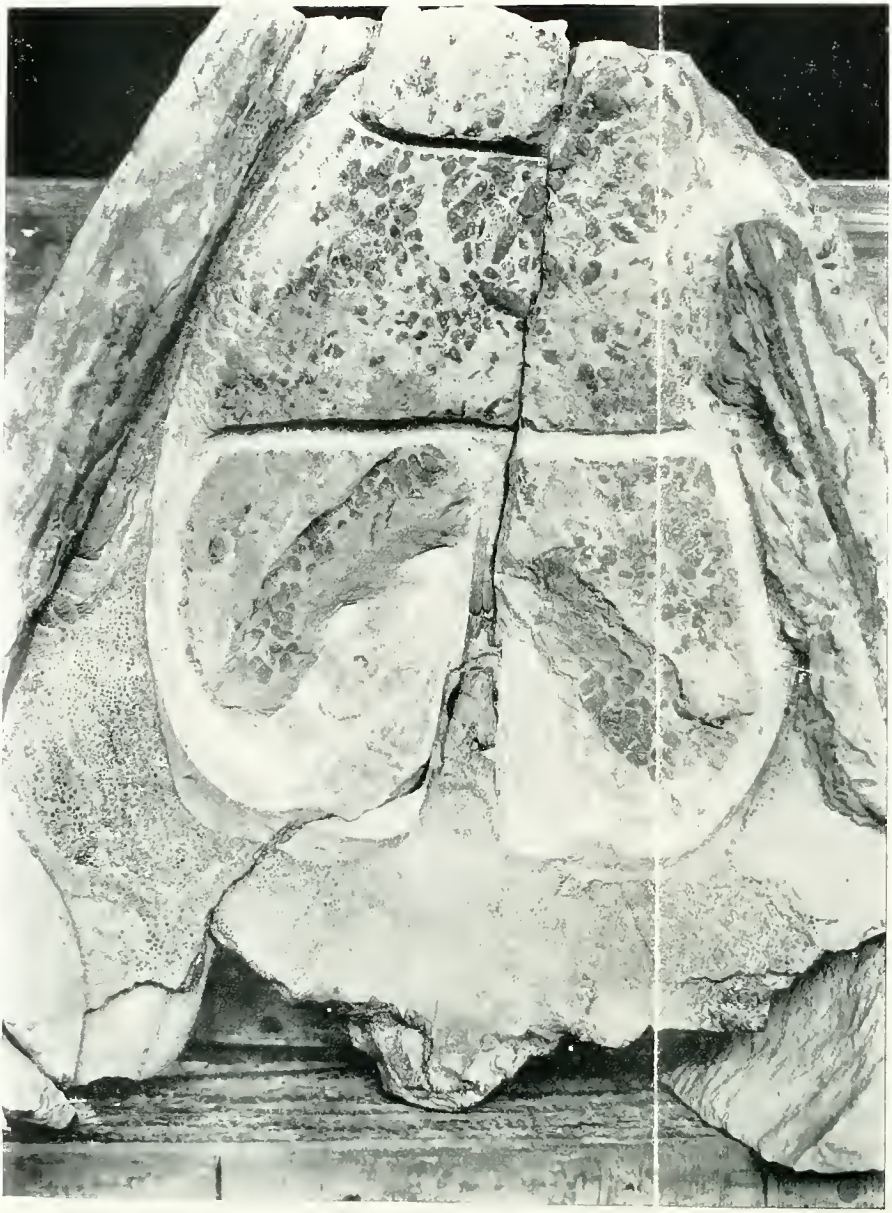
Fig. 8. Dorsal view, about natural size. ♀.



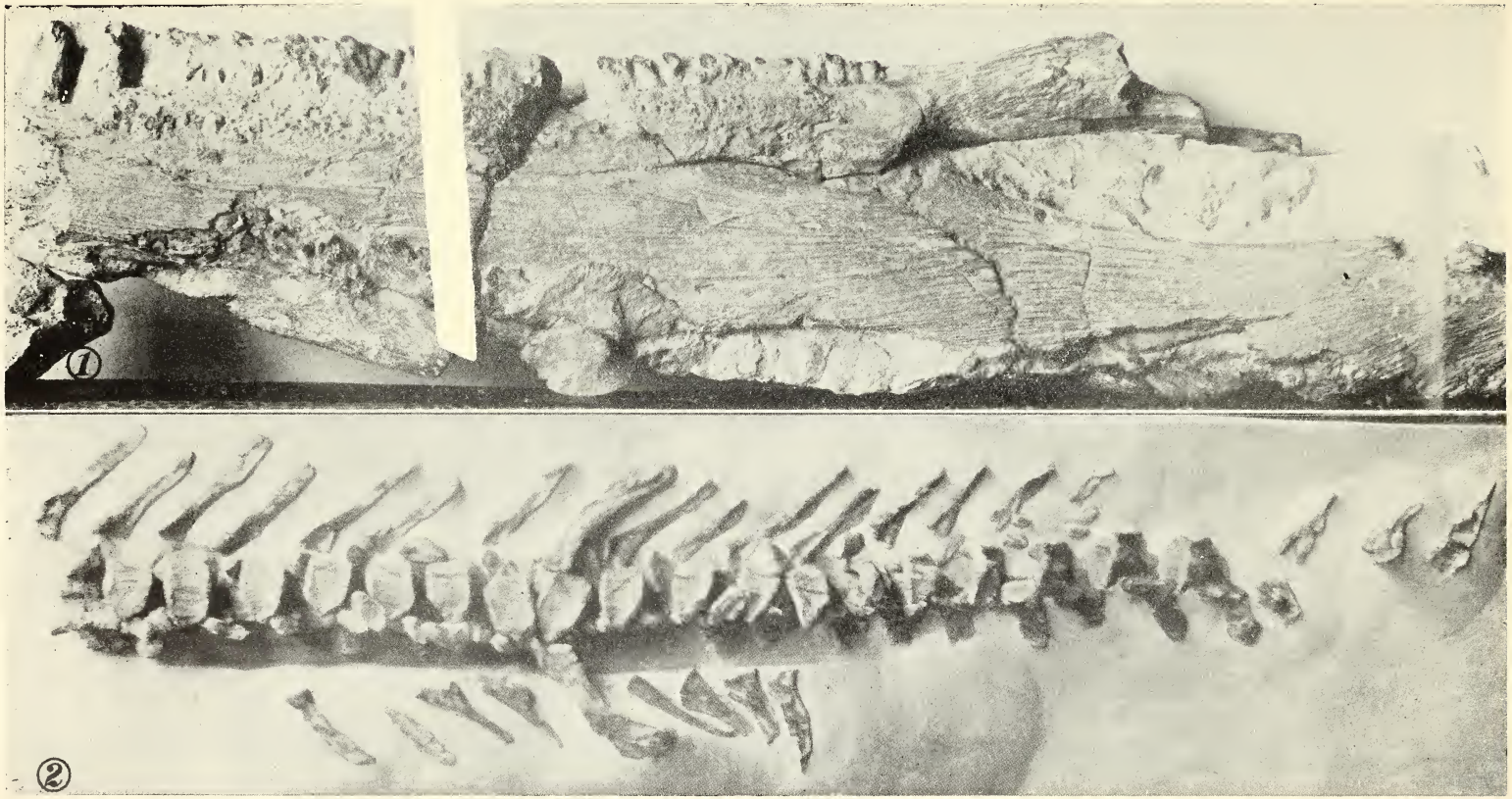
Myriodon senekalensis. The large block of the remains. About 1 : 16.

Myriodon senekalensis. The smaller block of the remains. About 1 : 11.

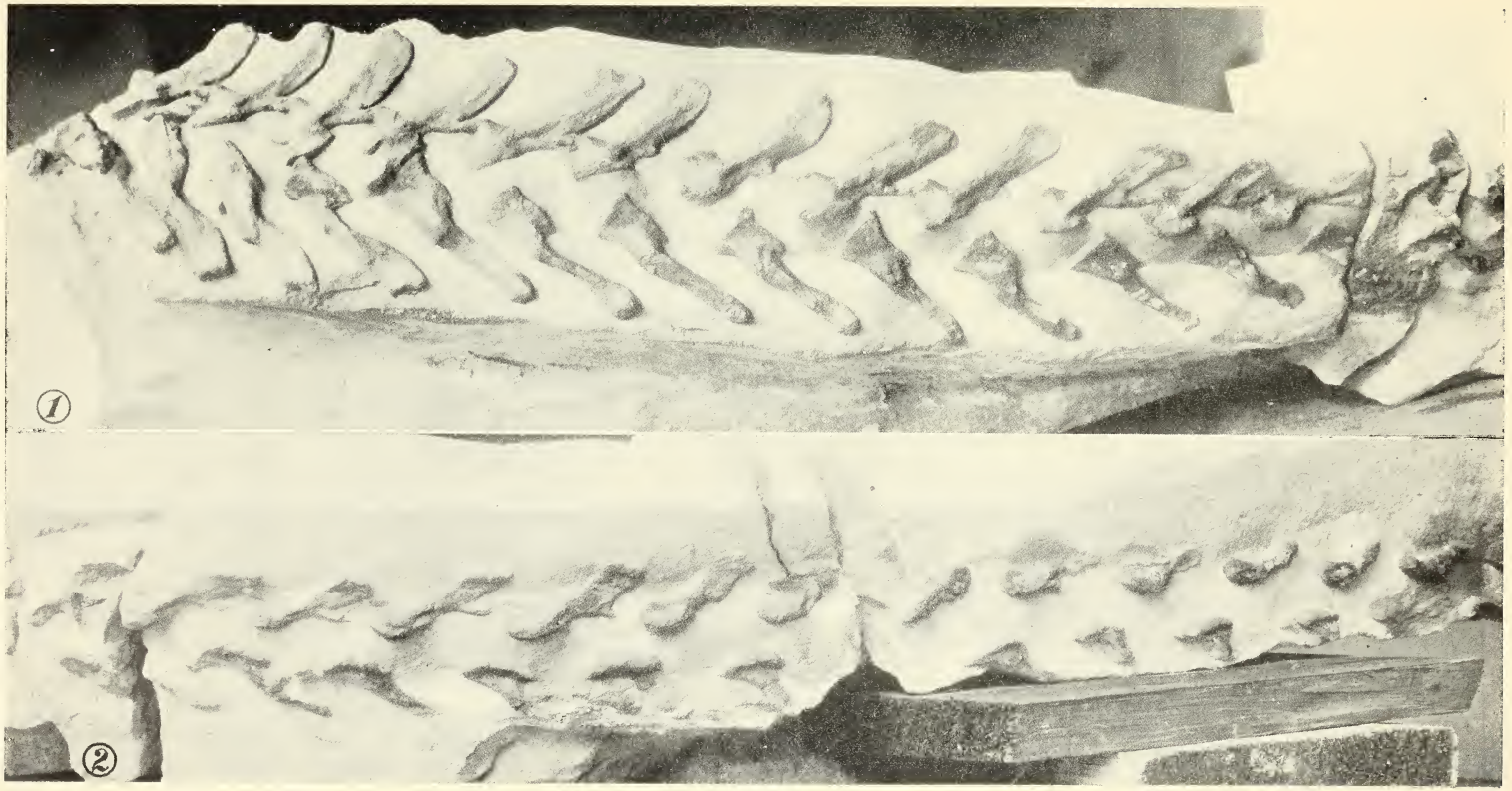




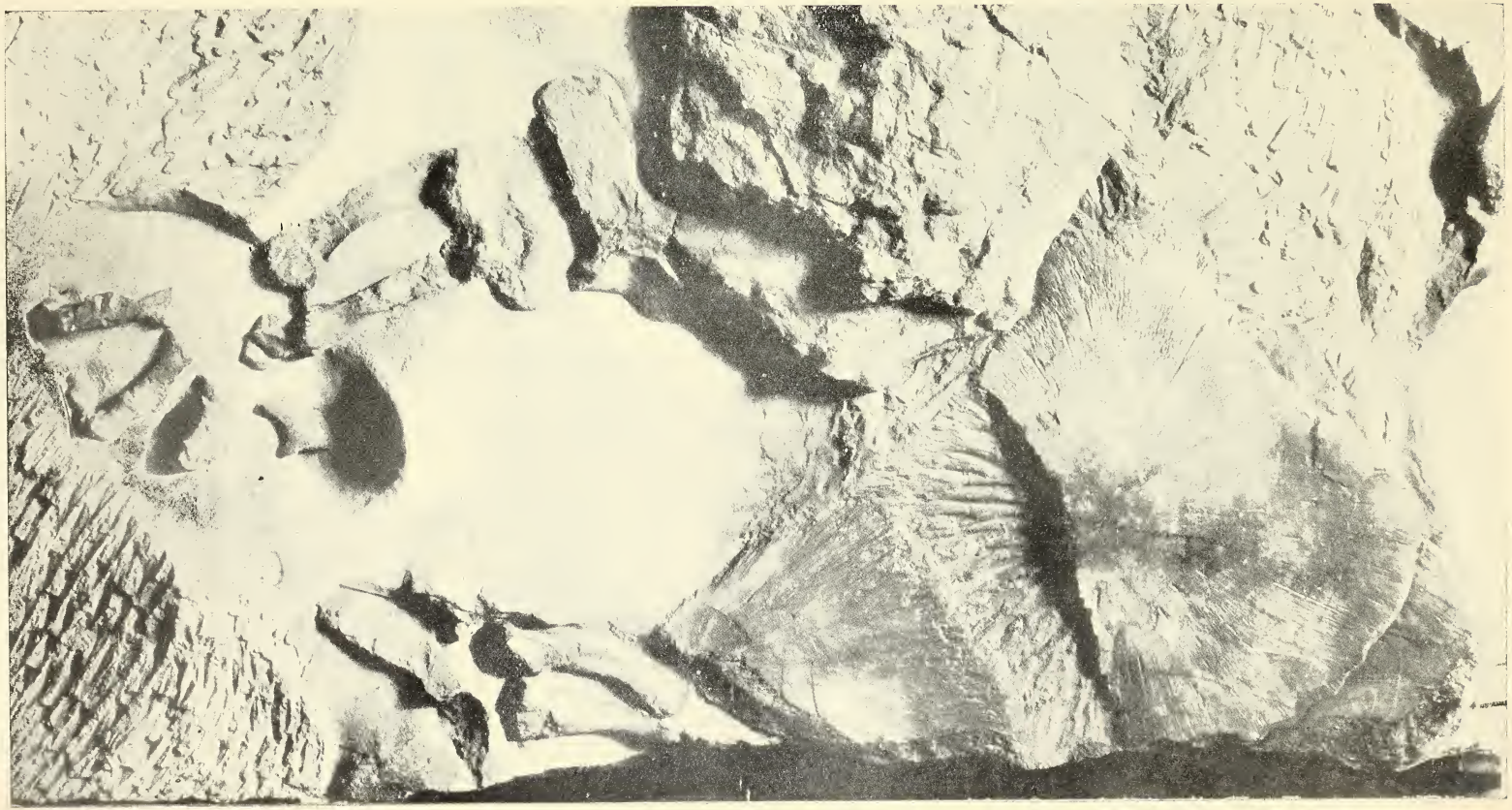
Myriodon senekalensis. View of the palate. × 0, 6.



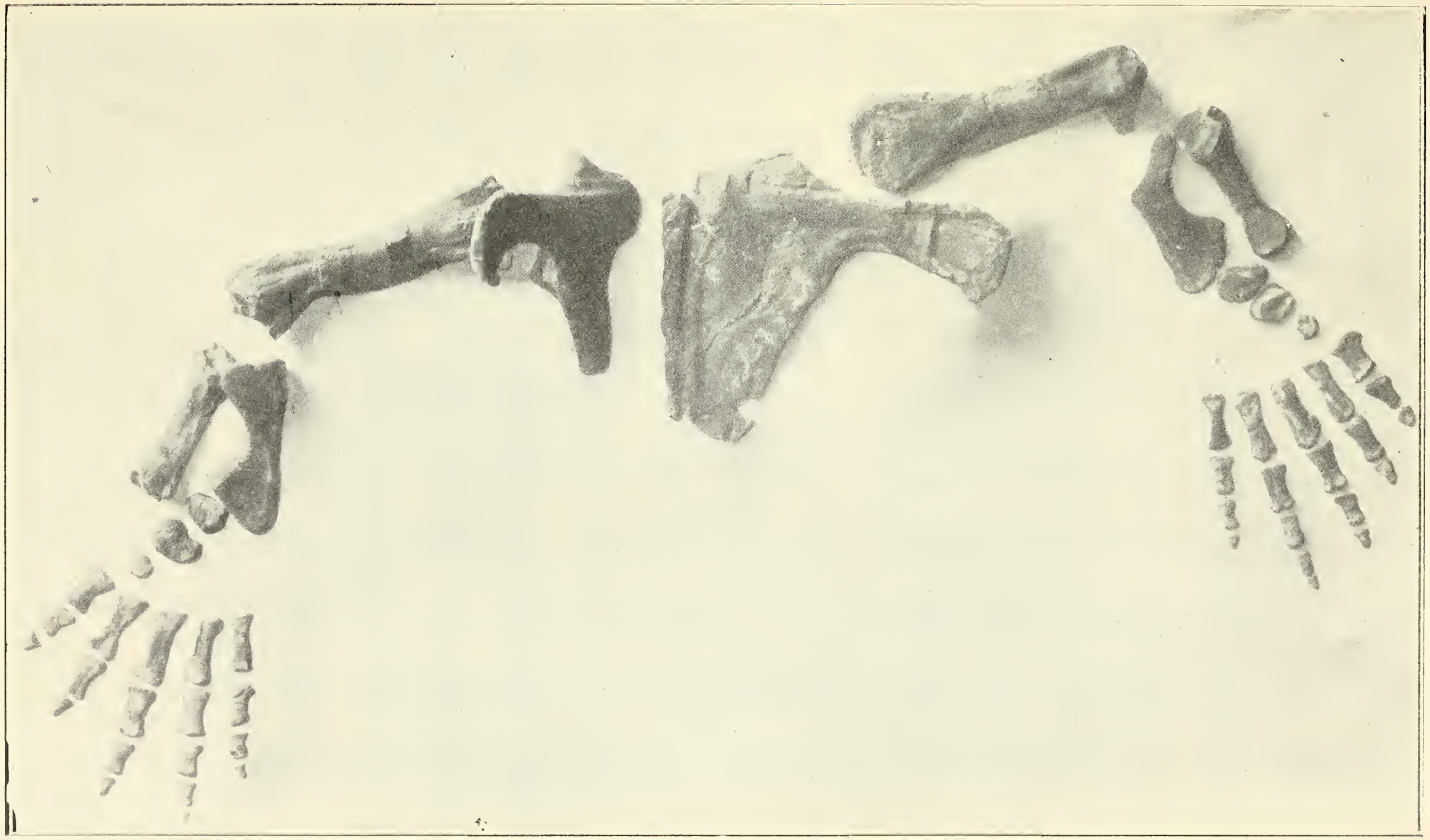
Myriodon senekalensis. Fig. 1. Right ramus of lower jaw. Nearly 0,8. Fig. 2. Vertebral column with sacral vertebra and ribs. About 0,2.



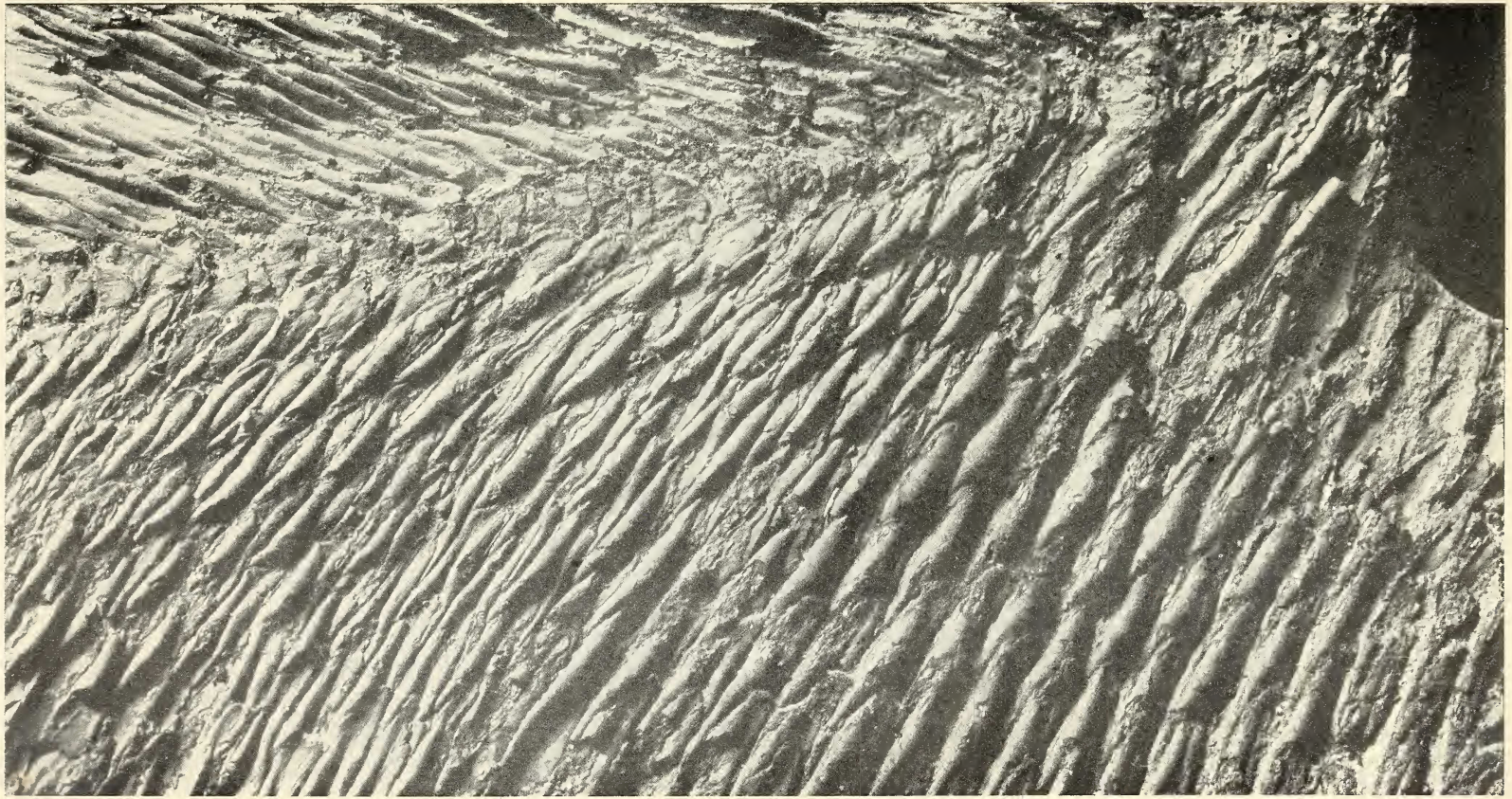
Myriodon senekalensis. A large portion of the skeleton of the tail. About 1 : 3.



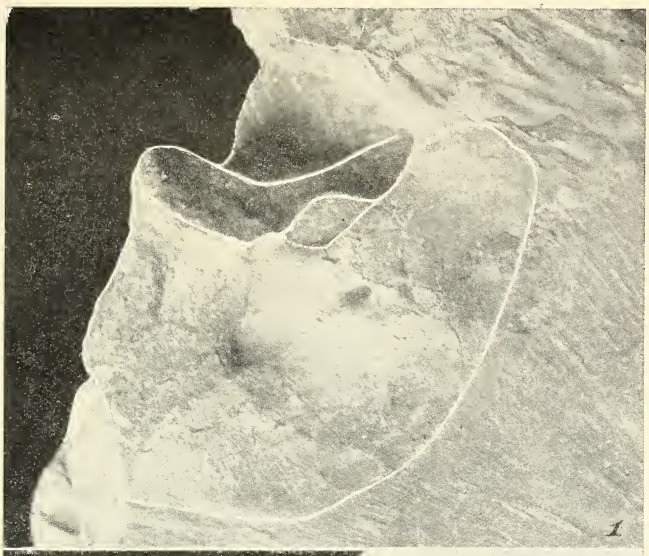
Myriodon senekalensis. Shoulder-girdle and front leg. Abont 1 : 3.

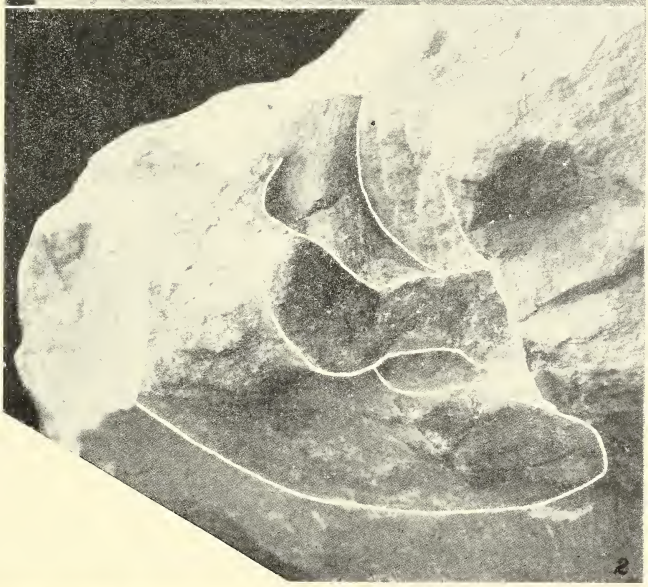


Myriodon senekalensis. Pelvis and hind legs. About 23 : 100.



Myriodon senekalensis. A portion of the dermal armour. About 0,9.





Myriodon senekalensis. Fig. 1, 2. Scapula-coracoid. About 0,8. Fig. 3. Right occipital condyle. Approx. nat. size.